SOME INVERSE PROBLEMS IN BIOMEDICAL IMAGING

James F. Greenleaf

Department of Physiology and Biophysics
Mayo Clinic
Rochester, Minnesota 55905
jfg@mayo.edu

Biomedical images are obtained using an energy form selected for the problem that is modified by the body or body part to produce a two or three-dimensional distribution of scattering that is recorded. This distribution is then presented in a display form and interpreted to deduce the distribution of properties responsible for the modification. The interpretation is universally done with the highly trained and experienced eye/brain combination of the subspecialist. To the surprise of most engineers, physicists and mathematicians, quantitative numbers are not required, and are seldom used in medical imaging. However knowledge of the forward and inverse problems help the design engineers to stabilize the imaging systems so that the images can be trusted to be representative and consistent. Thus there remains a need for inverse solutions to a wide range of biomedical imaging problems. These solutions can be used to design new imaging methods and to estimate the expected contrast and signal to noise ratios within the images. Current imaging approaches are migrating from images of structure to images of function. Biomechanical considerations are used when the function of the organ is associated with movement or change in shape. This greatly complicates the inverse problem and often requires interaction between the physician and the engineer, mathematician or physicist. Examples of current biomedical imaging problems will be discussed.